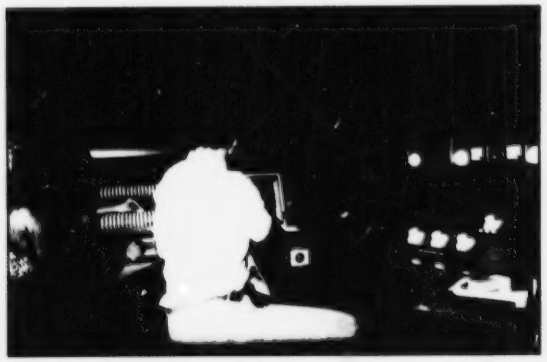
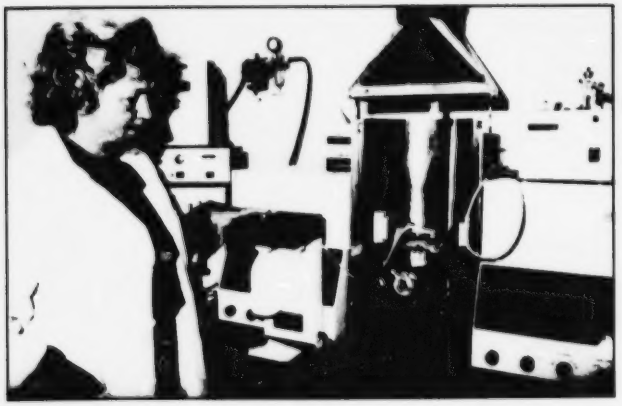
Secretariat on Science, Research and Development
For the year ended March 31, 1983





Part of the control console built to operate the Planetec automation system at Vancouver's H.R. MacMillan Planetarium.

Mrs. Stanya Horsky is part of a research team at the University of British Columbia studying how plants reveal the presence of minerals in the ground beneath them.

Research continues under Dr. Harold Weinberg at Simon Fraser University into ways of using the SQUID biomagnetometer built by CTF Systems of Coquitlam.

At Seakem Oceanography near Sidney, B.C., Kathy Thompson works with Dave Popham studying tissue samples taken from oysters living near log booms in Ladysmith harbour.

Dr. William Armstrong in conversation with Dr. Patrick McGeer, Minister of Universities, Science and Communications, shortly after Dr. Armstrong had received a citation naming him an honorary member of the Science Council.

Science Council members are led by Dr. Erich Vogt on a tour of the TRIUMF nuclear research facility near Vancouver.

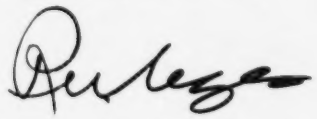
The Honorable Patrick L. McGeer,
Minister of Universities, Science
and Communications,
Province of British Columbia,
Parliament Buildings,
Victoria, B.C., V8V 1X4

June 30, 1983

Dear Dr. McGeer:

In accordance with the requirements of Section 5, of the Science Council of British Columbia Act, I have the honor to present to you the Fifth Annual Report of the Science Council of British Columbia, and of the Secretariat on Science, Research and Development for the year ended March 31, 1983.

Respectfully submitted,



Robert W. Keyes,
Chairman,
Science Council of British Columbia.

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Members

Mr. R.W. Keyes
Consulting Economist

	Date of Appointment	Current Term Expires
Mr. R.W. Keyes, Chairman	December 14, 1978	January 20, 1984
Dr. W.M. Armstrong	January 29, 1982	(Honorary Life Member)
Mr. G.S. Balcom	March 24, 1983	March 24, 1985
Dr. J.F. Cochran	July 30, 1981	July 30, 1984
Dr. D.H. Copp	January 30, 1981	February 25, 1985
Dr. H.M. Ellis	November 23, 1979	January 20, 1984
Dr. O.L. Forgacs	June 29, 1978	January 30, 1983
Dr. J.C. Madden	July 15, 1981	July 15, 1984
Mr. R.D. Malcolm	September 18, 1980	January 20, 1984
Dr. V.A. Mode	January 30, 1981	February 25, 1985
Dr. J.D. Murdock	July 12, 1979	July 12, 1983
Dr. R.A. Nodwell	July 15, 1981	January 15, 1984
Dr. T.W. Pearson	December 3, 1981	December 3, 1983
Mr. S.C. Rooney	March 6, 1980	April 28, 1984
Dr. P.C. Trussell	June 29, 1978	July 15, 1983
Dr. L.M. Wedepohl	November 23, 1979	July 15, 1983
Mr. H.M. Wright	November 2, 1978	January 20, 1984

Research Secretariat of British Columbia

Dr. J.T. Sample, Executive Director
Dr. M.A. Cairns, Associate Director

Dr. W.M. Armstrong
Honorary Member

Dr. J.F. Cochran
Dean of Science
Simon Fraser University

Dr. D.H. Copp
Dept. of Physiology
University of British Columbia

Dr. H.M. Ellis
Director, Research and Development
B.C. Hydro

Mr. G.S. Balcom
Vice-President
Sydney Development Corporation

Dr. J.C. Madden
President
Microtel Pacific Research Ltd.

Mr. R.D. Malcolm
Barrister & Solicitor, Ladner Downs

Dr. V.A. Mode
Director, B.C. Research

Dr. J.D. Murdock
President, Chemetics International Ltd.

Dr. R.A. Nodwell
Dept. of Physics
University of British Columbia

Dr. T.W. Pearson
Dept. of Biochemistry & Microbiology
University of Victoria

Mr. S.C. Rooney
President, Durand Machinery Co. Ltd.

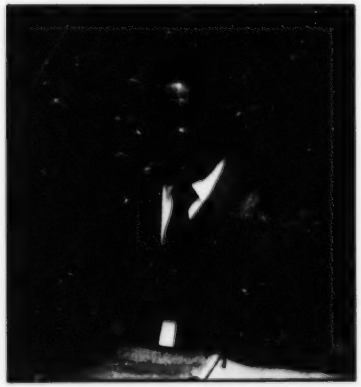
Dr. P.C. Trussell
Chairman, Forest Research Council

Dr. L.M. Wedepohl
Dean of Applied Science
University of British Columbia

Mr. H.M. Wright
Chairman, Wright Engineers Ltd.

Dr. J.T. Sample
Executive Director
Research Secretariat of B.C.

From The Chairman



This has been the watershed year for the Science Council of British Columbia. Plans and programs discussed by the members of the Science Council early in its first two years of operation are now firmly launched or well into development. This year saw the sixth and seventh competitions for research funds concluded. The *Science and Engineering Gold Medal Awards* for distinguished achievement in science and technology have become recognized in the community as worthy of merit. The *joint programs with industry* to encourage the employment of graduate students and post-doctoral fellows in industrial research and development are expanding. The *Innovation Office* is in operation. The Council's *public education programs* entered the public school system for the first time. And, finally, but by no means least, *some modest commercial successes* for projects funded by the Science Council have been realized. All of these, and other activities, are outlined in this report in more detail. Three programs that focus on the Council's objective of *assisting in the diversification of the provincial economy* are worth special mention here.

The first is the Science Council's research competitions for grants in aid of research and development. During the year, more applications were received from the private sector than ever before. The distribution of funds to commerce and industry for research and development also reached an all-time high. The Council places a high priority on stimulating research and development by industry. In keeping with this objective, the Science Council requires, as a condition for grants, that the research it sponsors at the province's universities must be done in cooperation with a private organization. This aspect of the Council's policy is succeeding in encouraging more joint research by industry and the universities. This thrust has continued throughout this fiscal year, despite the deterioration in British Columbia's economic fortunes.

Second, the Science Council expanded its public education efforts to include the public school system in a more positive way. The future development and maintenance of technology-based industry in the province depends heavily on adequately trained people with the interest, desire and skills to work at these activities. The supply is short even now. The Council is continuing this dialogue with students and teachers so as to make students more aware of the potential opportunities in science and technology. In this way we hope to promote the long term diversification of the provincial industrial base.

The third program, which is now underway, involves the actual transfer of the new or improved technology to the marketplace. The *Innovation Office*, which the Science Council, in consort with the Discovery Foundation and Discovery Parks, established during the year, is now functioning. The Innovation Coordinator plans to increase his efforts to assist researchers on projects funded by the Science Council to gain access to the commercial market. The staff of the Science Council is preparing a catalogue of progress on projects funded over its first five years. This catalogue will show progress through the process of research to development and, finally, to the market . . . i.e. from the laboratory, to bench model, to prototype, to production, and sale. Some limited commercial successes have already emerged or will be in the marketplace within the year. These include:

a simple and economical-to-apply material to reflect heat rays from windows,

a micro processor-driven device for determining water quality, quickly and economically,

a machine to plant tree-seedlings for reforestation on rolling terrain,

and a biomagnetometer to supplement such established diagnostic procedures as electroencephalography (E.E.G.) and electromyography (E.M.G.).

Other examples are just as encouraging. In fact, the Council's own video/film presentation, "Images for Tomorrow", introduced a new technology for video to film transfer in documentary presentations. A new video/film is planned.

The face of British Columbia industry will not change overnight as a result of the Council's program of grants-in-aid. It will, over time, show new facets for profit, and new techniques for efficiency in existing operations.

The Science Council developed a set of policy guidelines shortly after its inauguration in 1978. These were detailed in the Fourth Annual Report (1981-82). Last year, we indicated that the guidelines were under review. This review has been completed and a new policy for research and development for the province was approved by the Council in November, 1982. The basic objectives of the original policy are unchanged, but the new guidelines recommend to the Government, research agencies and private business, new methods by which science and technology can be nurtured and encouraged. These new guidelines are reprinted in detail, beginning on page 40.

It bears repeating that British Columbia depends heavily for employment and tax revenue upon the prosperity generated from the products of our forests, rivers and seacoast, fields, and deposits of minerals. The international markets to which these products flow can be quite volatile as our recent experience shows. Diversification through upgrading the value of the natural resources of the province before trade occurs; and diversification into endeavours not directly related to our natural resources, such as in high technology, are essential to mitigate the worst impact of the international business cycle. The Science Council programs just described are directed to this objective of diversification. They are beginning to bear fruit. Nonetheless, the competition is keen, even within Canada, for "high technology" business. So we should not expect instant success.

In conclusion, I am pleased to recognize the support of our staff during this past year.

Robert W. Keyes

Introduction

The Science Council has identified **eight** major areas where its grants should achieve early positive results:

- Agriculture and Food
- Aquatic Sciences
- Electronics and Communications
- Energy
- Forests and Forest Products
- Manufacturing and Machinery
- Mining, Minerals and Metals
- Transportation

Subcommittees of the Science Council, composed of individuals involved in the research, production, operating or marketing phases of each area, assist the Science Council by reviewing applications and making recommendations for the support of the most promising projects. Competitions for research grants take place twice a year.

Agriculture and Food

British Columbia's climate and geography make it necessary for us to import certain fruits and vegetables. But, we can produce most popular foods locally while realizing enough of a surplus to permit some exports. However, arable land in our mountainous domain is limited and, in some parts of the province, is affected by urban and industrial development. The Science Council wants to insure that our agricultural resources are as productive as possible and that efforts are made to develop better crops and livestock and a wider range of food products from them.

In the two competitions held during the 1982-83 fiscal year, projects in this category received **$305,000** or 8.4% of the total value of grants awarded. The projects included:

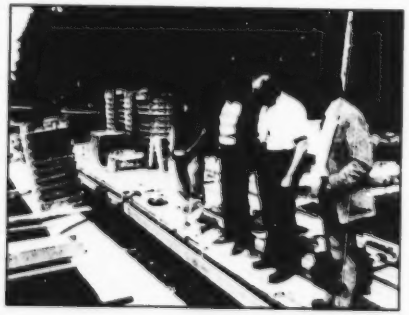
work on the development of a spray fertilizer from local kelp,

the evaluation of the potential use in British Columbia of a wide variety of nursery plants from other parts of the world,

efforts to establish an economical honeybee package and queenbee industry in British Columbia,

assessing the feasibility of using the recently-developed UBC prism light guide as a means of carrying light to small green house plants.

Science Council members Robert Malcolm and Robert W. Keyes and Research Secretariat Executive Director Dr. J.T. Sample look on as R.G. Saunders explains the shellfish rearing system his company has developed at Bamfield.



Aquatic Sciences

In the Aquatic Sciences, all areas relating to our water resources are considered, but the emphasis is on the preservation and health of the sea creatures that are a basic source of food for domestic and foreign markets. In order to maintain stocks of fish and plants in the rivers and sea, the Science Council is supporting a number of research initiatives. Among these are several that involve **fish-farming** or **fish-ranching** and which aim to insure a reliable supply of salmon, trout and shellfish, regardless of variations in the natural populations.

In the 1982-83 year, the Science Council awarded grants in the Aquatic Sciences worth a total of **$722,050**, which is 17.7% of the value of grants awarded. Among them were the following:

the development of a portable water-quality sampler that will help in the detection of metals, hydrocarbons and pesticides in water,

continued work on floating chambers that will permit salmon fry and various shellfish species to develop in more natural conditions,

refinements to a technique for supercooling salmon eggs so that fisheries biologists will have a ready supply of stocks having superior genetic characteristics,

final development of a tropical fish food dispenser that can be activated on demand by fish in home aquariums.

Electronics and Communications

Some of the most dramatic achievements in British Columbia science are taking place at the speed of light. Satellites in earth orbit are relaying information to geographers, mining engineers and forest researchers enabling them to make vital decisions about the management of our natural resources. One Richmond firm has established a world-wide reputation for the quality of the software in its satellite-receiving systems, and the Science Council played an important role in helping to pay for research into improving the images produced by that equipment.

At the other end of the scale, miniature solid-state chips using B.C.-produced gallium arsenide in place of the usual silicon are coming into wider use all the time. A major mining and metallurgical firm refines the gallium and arsenic in its B.C. plant, making them into the semi-conducting gallium arsenide compound. Research into the characteristics of gallium arsenide is being sponsored by the Science Council both at the company and at the University of British Columbia.

Science Council grants totalling **$575,893** were awarded to B.C. researchers in 1982-83, an amount that represented 12% of the total. These included:

a study of the ways both users and programmers interact with the Telidon information communications system,

a small and inexpensive refrigerator, or "cryocooler", in which exceedingly low temperatures can be produced so that electronics firms can work with super-conducting materials in the fabrication of advanced circuitry,

research aimed at developing new devices for detecting gas leaks in a variety of situations,

the development of a computerized technique for simulating the acoustical characteristics of a room or auditorium while it is still in the design stage.

Dave Green and his associates at Seakem Oceanography have developed a light-weight water quality sampler that can detect minute amounts of metals, hydrocarbons and other pollutants in both still and flowing water.

In his small lab in Victoria, Roger Soar is testing the effectiveness of high frequency sound as a way to control Eurasian milfoil, a weed that has choked the shorelines of many inland lakes in the province.

Energy

The members of the Science Council are as concerned as anyone about the conservation and efficient use of our energy supplies. Examination of the energy-containing resources of British Columbia reveals almost no petroleum, but abundant water-power potential, large quantities of coal and natural gas and, to some extent, waste wood. So, the Science Council is supporting a number of projects that should lead to the more efficient use of the energy sources available to us.

A major study into the opportunities for converting coal to liquid fuel was commissioned by the Science Council several years ago. Because of this study, a number of projects involving coal were initiated. The Science Council is also eager to see the wider use of methane (natural gas) as a fuel for cars and trucks and has supported studies into the most economical ways of converting vehicles to run on this fuel.

In 1982-83, the Science Council awarded grants in the Energy field totalling **$470,075**, which was 8.8% of the overall amount for the year. These included:

two separate projects directed towards the production of a simple, effective means of coating windows to prevent the flow of heat through them while permitting visible light to pass through unimpeded,

research aimed at determining which method is best for depositing cadmium selenide on solar collecting panels,

the development of rechargeable storage batteries that use lithium and molybdenum disulfide to power electric cars, tools and games.

Forests and Forest Products

Forestry is British Columbia's number one industry and, despite the battering it has taken during the world-wide recession, it is likely to maintain its position in our economy for years to come. The Science Council is encouraging the forest industry to adopt new methods and advanced technology which will help it to stay competitive.

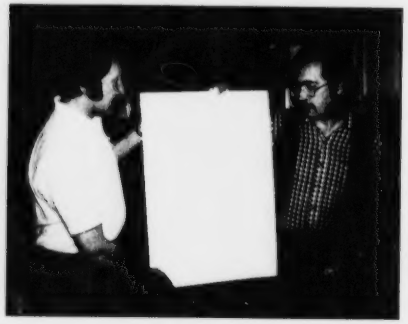
Efforts are being made to come up with safe and effective techniques that will insure that seedlings can withstand the attacks of pests and parasites and grow quickly into healthy trees. The Science Council is also providing funds for scientists to aid their attempts to find uses for parts of the trees now considered waste, and it is supporting another group of projects dealing with forest products such as lumber and pulp.

Forests and Forest Products research received **$1,699,319** from the Science Council in 1982-83. That represented 32.5% of the overall total. Among the many projects were the following:

studies into ways of reducing noise and vibration in chain saws,

the development of a dart or lance tha will safely inject a herbicide into unwanted

Dr. Richard Ring and graduate student Lee Humble are working at the University of Victoria to isolate and identify the pheromone (female sex attractant) of the winter moth, a species that attacks the foliage of many Vancouver Island shrubs and small trees.



hardwood trees that grow in evergreen forests and reduce the efficiency of logging,

a method of using earth satellite images for the early detection of bark beetles,

a process that will reduce or eliminate the reddish colour that occurs in pulp made from cedar wood.

Manufacturing and Machinery

In the long run, the Science Council's success will be measured by the number of new products and systems that widen the base of high technology manufacturing in British Columbia. Some of these have been mentioned in other categories.

During 1982-83, the Science Council awarded Manufacturing and Machinery grants totalling **$544,365**, which is 11.2% of the total. The most prominent were the following:

a machine that will recover the expensive radioisotope xenon 127 after it has been used in medical diagnosis, then purify it so it can be used again,

a portable device for converting salt water to fresh, using solar power,

an improved lubricant dispenser for industrial use throughout the world,

studies into the requirements for making larger electrolytic cells for use in the production of sodium chlorate for the pulp-bleaching process.

Mining, Minerals and Metals

There's a lot more to mining than just digging rock out of the ground! First, in order for the operation to be profitable, there must be an efficient method of separating and concentrating the ore from the surrounding material and, in turn, the minerals from the concentrates. Environmental and safety concerns are important, too.

In 1982-83, the Science Council invested **$265,724** in Mining, Minerals and Metals research, an amount that represents 6.8% of the total. Among the major projects are the following:

the use of microbes to remove metals such as copper from sulfide concentrates,

an attempt to find a mathematical correlation between the rate at which a drill moves through rock and the hardness of that rock so that the quantity of explosive needed for a particular result can be more accurately estimated in advance,

testing a new method for recovering tin at the Sullivan Mine in south-eastern British Columbia.

G.R.E.A.T. scholarship winner Jennifer Sherlock is studying the propagation and growth of two commercial shrubs at Reid, Collins Nurseries in Aldergrove, under the supervision of Dr. Roy Taylor, director of the U.B.C. botanical gardens.

Transportation

Moving people and goods around and through British Columbia presents many challenges. Our urban areas, too, provide plenty of opportunity for research into improved methods of transportation. As Expo 86 approaches, with its focus on transportation, the Science Council hopes to be supporting an increasing number of projects aimed at solving some of the problems in transportation unique to this part of the world.

In 1983, just one project, worth **$29,500**, and accounting for less than 1% of the total awarded in the year, received support from the Science Council in the transportation category. It involved an investigation into ways of improving the stability and seaworthiness of small commercial vessels used in our coastal waters. A few other projects, relating to transportation, are included among the other categories.

Activities

The Science Council

During the year from April 1, 1982 to March 31, 1983, the Science Council of British Columbia held twelve formal meetings, ten of them at the Research Secretariat offices in Richmond, one at the TRIUMF nuclear research facility and one at Simon Fraser University.

Council members also participated in the work of the Evaluation Subcommittees which review grant applications, the Scholarship and Fellowship Subcommittee, which reviews applications for graduate and post-doctoral fellowships in science and engineering, and in special committees dealing with matters such as Policy, Patents, and Public Relations.

Research Policy

The policy guidelines under which the Science Council operates were established in 1978. They are as follows:

1. To consolidate and expand employment and output of existing industries by establishing, maintaining and improving their competitive position (especially in export markets) through research and development activities. Particular attention will be given to the maintenance of long-term productivity of the province's forests, mines, agricultural lands and waters and to the further development of fossil fuel resources.

2. To stimulate new industrial opportunities in the province through the establishment of technology-based manufacturing and service industries.

3. To improve the quality of life in British Columbia by providing the finest health care research, developing the finest medical services at the most reasonable cost and by reducing industrial and urban pollution and, in general, protecting the natural environment from lasting damage.

4. To facilitate in all recognized disciplines the accumulation of scientific and technological excellence in the region and, in so doing, provide opportunities for the young people who are receiving advanced training in our educational system to become involved in the social and economic development of the province.

In November, 1982, the Science Council prepared a series of recommendations for a provincial research and development policy for the 1980's. These recommendations and their supporting documentary material are reproduced beginning on page 40 in this report.

Research Grants

There were two competitions for research grants in the year ending March 31, 1983. In the first, known as RC-6 (indicating it was the 6th Research Competition to have taken place since the establishment of the Science Council) a total of **$1,457,432** was awarded to 33 projects, of which 21 were new ones and 12 were renewals of projects initiated in earlier competitions.

The spring competition, RC-7, set a record both for projects supported and the amount of money distributed among them. Fifty-eight projects, 30 of them new and 28 renewals, shared a total of **$3,378,094**.

Through the year as a whole, grants were shared about evenly between the three universities on the one hand and the private sector on the other. Research projects at a number of non-profit research institutes received just over 10% of the Science Council's research funds.

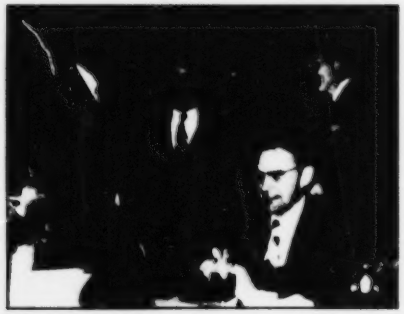
Scholarships and Fellowships

The **G.R.E.A.T.** program (Graduate Research, Engineering and Technology), designed to encourage graduate students to work on research projects of interest to local companies, and the **I.P.D.F.** program (Industrial Post-Doctoral Fellowship) established to stimulate the employment of recently qualified Ph.D.'s in private industry, have been continued for a fifth year, administered by the Research Secretariat.

The G.R.E.A.T. awards provide a yearly scholarship, worth $11,500 in 1982-83, for a maximum of three years, to graduate students at B.C. universities who are working on projects in cooperation with local industries and organizations. During the past year, 38 scholarships were renewed and 54 new awards were made, for a total of 92. Taken together, they were worth **$1,058,000**.

The I.P.D.F. provides an annual subsidy of $25,000 for a maximum of two years to the salary of a recently qualified Ph.D. employed by a B.C. company. This is to encourage companies to develop their research capabilities and allow the fellowship winner to experience an easier transition from an academic background to an industrial one. One new fellowship was awarded in 1982-83 and two were renewed.

Simon Fraser University Physics professor Dr. Anthony Arrott receives his gold medal and citation from Science Council chairman Mr. R.W. Keyes, as Research Secretariat Associate Director Dr. Max Cairns looks on.



Science and Engineering Gold Medals

The Science and Engineering Gold Medals are awarded for outstanding achievements by scientists and engineers in one of the following four categories: Natural Sciences, Engineering and Applied Sciences, Health Sciences and Industrial Innovation. In order to qualify, an individual or research team must have done the work in British Columbia or, in the case of an individual, must be normally resident in the province, if some of the work cited has been done elsewhere.

Three winners were announced at the annual awards dinner held in Vancouver in October, 1982, and each received a gold medal and a handsome citation.

The winners were:

Dr. Anthony S. Arrott of the Simon Fraser University Department of Physics. He was acclaimed for research that has helped to clarify the experimental problems involved in determining the Curie temperature, the temperature at which ferromagnetic materials begin to

lose their magnetic properties.

Dr. Julia Levy of the Department of Microbiology at the University of British Columbia. Dr. Levy and her research associates have developed a sensitive, rapid and inexpensive test for the early detection of lung cancer. The test involves the discovery in human blood serum of minute antibodies which are produced naturally to attack tumours.

Techwest Enterprises Ltd. A design and engineering team at this Vancouver firm has devised a system that helps provide stability for cranes used to lower supplies to crews working underwater. Despite the swells that may rock a vessel to and fro the so-called Heave Compensation System compensates for them, thus the winch cable remains taut and the supplies may be lowered or raised with a steady motion.

An honorary membership in the Science Council of British Columbia was awarded to Dr. W.M. Armstrong, first Executive Director of the Research Secretariat of British Columbia.

Among the speakers at the awards dinner were Dr. Larkin Kerwin, President of the National Research Council of Canada, Dr. Patrick McGeer, Minister of Universities, Science and Communications and Mr. R.W. Keyes, Chairman of the Science Council of British Columbia.

Innovation Office

Working in partnership with Discovery Foundation, the Science Council moved to establish British Columbia's first and, so far, only Innovation Office. Keith McPherson was appointed Co-ordinator of the Innovation Office in October, 1982. Since then he and an assistant have handled more than one thousand inquiries.

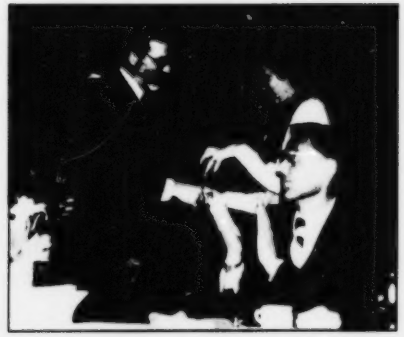
The Innovation Office was set up to help people bring their projects to the point where they can enter the marketplace. Through a variety of activities, including clinics devoted to prototypes, business planning and marketing; seminars and workshops on technology, the requirements of potential customers, and patents; the Innovation Office hopes to stimulate the entire process of taking an idea and seeing it through to commercial success. Accordingly, a prime activity will be putting innovators, investors and industry in touch with one another. At the same time, the Office will make it clear that these specific participants in the innovation process must do most of the work themselves.

The costs of operating the Innovation Office are shared equally between Discovery Foundation and the Science Council.

Public Relations

The Science Council's 22-minute film, Images for Tomorrow, was cited for Creative Excellence at the 1982 United States Industrial Film Festival in Chicago. It has been shown to business and professional groups throughout the province. In 1982-83, it was presented as part of talks given by Council members and staff in Kamloops, Penticton, Prince Rupert and Vancouver.

Dr. Julia Levy of the University of British Columbia receives her Science and Engineering gold medal.



Mr. R.J. Sanders accepts the gold medal on behalf of the Heave Compensation System design group at Techwest Enterprises Ltd.

A section of the Science Council's attractive exhibit at Innovation 83

Barb Bunting works with Bamfield director Dr. Ron Foreman in studies of the phycocolloid production of coastal seaweeds.

Showings were also given to several school classes to show the variety of careers that are open in science and technology.

The Science Council's exhibit on its activities and programs was updated to show projects underway in 1982, then put on view twice. First, it was shown in Robson Square in downtown Vancouver at the Ministry of Universities, Science and Communications' Discovery Fair in October. Then, in February, it was given prominence at Innovation 83, an exhibit and demonstration of future technology, produced by the Federal Government. The exhibit is designed to show what the Science Council is doing and to encourage people to take advantage of its programs.

The Council purchased the projection video equipment and exhibit structure, that it has rented in the past, so that it can set up its exhibit more frequently and with greater flexibility in the future.

The Council assisted the Ministry in its efforts to create a number of temporary summer jobs in science-based industries and employed five University of British Columbia students to conduct a survey of B.C. inventions from the past. The material they uncovered and the interviews they recorded have been transferred to the Provincial Museum's Modern History Department.

Other Activities

The growing importance of biotechnology and the issues raised by it prompted the Science Council to establish an ad-hoc subcommittee on the subject. The chairman is Council member Dr. Terry Pearson of the University of Victoria.

As a major contributor to applied research in the Aquatic Sciences, the Science Council decided to commission a study to evaluate the market potential for B.C. aquaculture and to identify those areas where additional technical research would be beneficial. The study is being conducted by Envirocon Ltd. whose report is due for presentation to Council in the summer of 1983.

Throughout the year, members of the Science Council and its sub-committees made a number of site-visits to projects being supported by Council grants. Among these was a demonstration of the new automation system installed in the H.R. MacMillan Planetarium in Vancouver. The system was designed and built by Planetec Ltd. of North Vancouver, which hopes to market it to other planetariums in the near future.

The Secretariat on Science, Research & Development

The primary responsibility of the Secretariat is to provide administrative and support services to the Science Council: preparation of material for meetings of Council and its various subcommittees, implementation of the Council's initiatives and programs of research grants and awards, response to public inquiries and the financial administration of the Council's affairs. In particular the Secretariat coordinates the procedures for the evaluation and funding

of research grants, G.R.E.A.T. graduate scholarships, industrial post-doctoral fellowships and the B.C. Science and Engineering Gold Medals.

The Secretariat provides a similar service to the B.C. Health Care Research Foundation which made 151 awards totalling $3.3 million during the past year. These awards are for the support of medical and health care research related to provincial problems and are funded by the B.C. Lotteries Fund. A brief summary of the awards made is given on page 38. A complete listing is available from the Secretariat, on request.

The Secretariat is also responsible for programs assigned to it by the Provincial Government. During the past year the Secretariat was asked to administer the reimbursement of the three B.C. universities for research expenses incurred by visiting Chinese scholars working here under a recent international exchange agreement.

The Secretariat also played a key role in the Province's High Technology Youth Employment Program, assisting the Ministry of Labour in the screening of applications.

Staff from the Secretariat attend meetings of the Internal Research Advisory Committee, the Provincial Government's research coordination and review body for in-house research by government departments. The Committee has representatives from all ministries involved in research activities and is chaired by Dr. R. W. Stewart, Deputy Minister of Universities, Science and Communications. Liaison with other provincial agencies with an interest in research and development (for example, B.C. Research, Discovery Parks and the newly-formed Forest Research Council of B.C.) is maintained on a regular basis. Similar contacts have been developed nationally with Federal Government agencies (Department of Supply and Services, Ministry of State for Science and Technology, National Research Council, Natural Sciences and Engineering Research Council, Science Council of Canada, Statistics Canada, etc.) and other provincial governments and research organizations.

International contacts included visits from representatives of the Organization for Economic Cooperation and Development (OECD) based in Paris, the South African Office of Science and Technology and the Ministry of Science, Technology and Energy of Thailand.

In support of the activities of the Council and Ministry, the Secretariat is developing an inventory of all research activity in B.C. Data on the levels of R. & D. funding in the universities, industry and Federal and Provincial Government departments has been collected, and a summary is given on page 39.

During the past year Dr. J. T. Sample, the Secretariat's Executive Director was a member of the organizing committee for the Canadian Research Management Association's Annual Meeting in Vancouver in October 1982. Dr. Sample was also appointed to membership of the Universities Council of B.C., the Terry Fox Medical Research Foundation and the Board of Pacific Isotopes and Pharmaceuticals Ltd.

Dr. John Webster, Associate Vice-president, Academic, welcomes Science Council members to Simon Fraser University.

Financial

Auditors' Report To The Minister of Universities, Science and Communications

We have examined the balance sheet of The Science Council of British Columbia and Secretariat on Science, Research and Development as at March 31, 1983 and the statements of research appropriations, expenditures and unexpended appropriations and operations appropriations, expenditures and unexpended appropriations for the year then ended. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as we considered necessary in the circumstances.

In our opinion, these financial statements present fairly the financial position of the Council and Secretariat as at March 31, 1983 and the results of their operations for the year then ended in accordance with generally accepted accounting principles, as modified by note 1 to the financial statements, applied on a basis consistent with that of the preceding year.

COOPERS & LYBRAND

Vancouver, B.C.
May 6, 1983

The Science Council of British Columbia and Secretariat on Science, Research and Development Balance Sheet as at March 31, 1983

Assets

	1983 $	1982 $
Cash and Short-Term Deposits	5,059,083	5,567,541
Accounts Receivable	50,259	58,812
Prepaid Expenses	4,640	1,991
	5,113,982	5,628,344

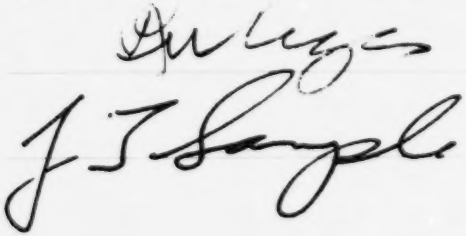
Liabilities

Accounts Payable and Accrued Liabilities	42,670	145,973

Unexpended Appropriations

Research (note 2)	4,938,786	5,335,564
Operations	132,526	146,807
	5,071,312	5,482,371
Commitments (note 2)		
	5,113,982	5,628,344

Approved by the Council and Secretariat



The Science Council of British Columbia and Secretariat on Science, Research and Development
Statement of Research Appropriations, Expenditures and Unexpended Appropriations
For the Year Ended March 31, 1983

	1983 $	1982 $
Research Appropriations		
Grants	3,834,750	5,380,872
Interest	734,235	697,955
	4,568,985	6,078,827
Research Expenditures		
Direct expenses and other	5,495	6,564
Graduate Research Engineering and Technology (GREAT) awards (see Schedule)	928,041	317,831
Grants (see Schedule)	3,842,097	3,311,810
Honoraria	11,600	7,900
Industrial Post-Doctoral Fellowships (IPDF) (see Schedule)	25,250	104,000
Public events (note 3)	57,625	96,628
Science and Engineering awards	14,968	14,918
Special requests (see Schedule)	73,120	25,000
Special projects (see Schedule)	7,567	
	4,965,763	3,884,651
Excess (Deficiency) of Appropriations over Expenditures for the Year	(396,778)	2,194,176
Unexpended Appropriations — Beginning of Year	5,335,564	3,141,388
Unexpended Appropriations — End of Year (encumbered by outstanding commitments) (note 2)	4,938,786	5,335,564

The Science Council of British Columbia and Secretariat on Science, Research and Development Statement of Operations Appropriations, Expenditures and Unexpended Appropriations For the Year Ended March 31, 1983

	1983 $	1982 $
Operations Appropriations		
Grants	374,576	340,524
Methane conference		79,074
Interest	12,234	42,308
	386,810	461,906
Expenditures		
Computer services	4,421	
Consulting fees	20,452	13,236
Furniture and equipment	19,068	45,415
Information services	21,446	21,798
Leasehold improvements		82,398
Meetings	2,838	1,989
Personnel recruitment	1,459	1,625
Photocopying and printing	29,239	34,059
Postage and courier	9,849	7,376
Professional fees	6,740	11,285
Publications	1,663	2,134
Rent	54,839	18,061
Salaries and employee benefits	261,380	204,446
Stationery and supplies	3,999	2,954
Telephone	12,935	7,690
Travel	11,508	7,759
	461,836	462,225
Other		
Cedar oil marketing study	2,062	43,257
Chinese international exchange		98,868
Methane conference		79,074
Public events (note 3)		4,797
	2,062	225,996
	463,898	688,221
Recovery of Expenditures		
British Columbia Health Care Research Foundation	47,258	28,595
Cedar oil marketing study		44,560
Chinese international exchange		94,628
Other	15,549	25,164
	62,807	192,947
Excess of Expenditures over Appropriations for the Year	(14,281)	(33,368)
Unexpended Appropriations Beginning of Year —	146,807	180,175
Unexpended Appropriations End of Year —	132,526	146,807

Notes

The Science Council of British Columbia and Secretariat on Science, Research and Development
Notes to Financial Statements
For the Year Ended March 31, 1983

1. Accounting Policies

Fixed Assets

Fixed assets are not capitalized and depreciated as assets of the Council and Secretariat, but are written off in the period in which they are purchased.

Research Grants

Outstanding research grant commitments are conditional on receipt of satisfactory progress reports and are not recorded until actually disbursed.

2. Research Grant Commitments (see Schedule)

During the year, the Council approved funding for research projects, awards, special requests and special projects totalling $5,872,737. At March 31, 1983, known outstanding commitments totalled $4,720,765 which, together with additional estimated renewed commitments of $2,242,731 amount to $6,963,496 in known and estimated outstanding commitments.

During the year the Council entered into an agreement whereby it shares certain costs associated with The Innovation Co-ordinator with The Discovery Foundation.

3. Public Events

During the year, the Council was involved in public events for the promotion of awareness of science and research in British Columbia. The three major events during the year ended March 31, 1983 were Discovery Fair, Innovation Fair and the travelling film production, Images for Tomorrow.

4. Lease Commitment

The Council is committed to an annual rental of $55,672 under a lease agreement which expires on March 31, 1984.

The Science Council of British Columbia and Secretariat on Science, Research and Development
Schedule of Commitments and Disbursements of Science Council Research Grants
For the Year Ended March 31, 1983

Research Grants	Known outstanding commitments beginning of year $	Additional commitments during year $	Disbursed during year $
Unsolicited Research Projects	83,745		78,745
Research Competition #1	37,645	(475)	18,000
Research Competition #2	194,754	(5,729)	128,912
Research Competition #3	410,831	(46,168)	124,370
Research Competition #4	1,232,791	15,404	750,922
Research Competition #5	1,589,337	(75,950)	787,989
Research Competition #6		1,457,432	789,371
Research Competition #7		3,378,094	1,163,788
	3,549,103	4,722,608	3,842,097
Awards			
GREAT's		931,874	928,041
IPDF's		56,500	25,250
		988,374	953,291
Special Requests			
Arts, Science and Technology Centre	75,000		25,000
Innovation Co-ordinator	100,000	50,000	25,620
UBC Robotics Grant		25,000	22,500
	175,000	75,000	73,120
Special Projects			
Aqua Culture Study		75,000	812
Schools' Book Prize		5,000	
Summer Catalogue Project		6,755	6,755
		86,755	7,567
	3,724,103	5,872,737	4,876,075

The Science Council of British Columbia and Secretariat on Science, Research and Development Schedule of Commitments and Disbursements of Science Council Research Grants for the year ended March 31, 1983 (Cont'd)

Research Grants	Known outstanding commitments end of year $	Estimated renewed commitments in 1983 - 1984 $	Known and estimated outstanding commitments at March 31, 1983 $
Unsolicited Research Projects	5,000		5,000
Research Competition #1	19,170		19,170
Research Competition #2	60,113		60,113
Research Competition #3	240,293		240,293
Research Competition #4	497,273		497,273
Research Competition #5	725,398		725,398
Research Competition #6	668,061	858,022	1,526,083
Research Competition #7	2,214,306	957,209	3,171,515
	4,429,614	1,815,231	6,244,845
Awards			
GREAT's	3,833	402,500	406,333
IPDF's	31,250	25,000	56,250
	35,083	427,500	462,583
Special Requests			
Arts, Science and Technology Centre	50,000		50,000
Innovation Co-ordinator	124,380		124,380
UBC Robotics Grant	2,500		2,500
	176,880		176,880
Special Projects			
Aqua Culture Study	74,188		74,188
Schools' Book Prize	5,000		5,000
Summer Catalogue Project			
	79,188		79,188
	4,720,765	2,242,731	6,963,496

Grants

Research Grant Competition #6 (RC-6)

A. Agriculture and Food

Grant Recipient & Organization	Project Description	Awarded
Dr. A. Bomke UBC, Soil Science	The development of a seaweed (*Macrocystis Integrifolia*) spray for use in agriculture crop production.	9,200
Dr. R.A. Ring UVIC, Biology	Field studies of pheromone attractancy in the winter moth, *Operoptera brumata*, and the span worm, *Operophtera bruceata*.	21,500
Dr. R.L. Taylor UBC, Botanical Garden	P.I.S.B.G. (Plant Introduction Scheme of the Botanical Garden).	70,000
Dr. P.M. Townsley UBC, Food Science	The continuous production of commercial mushrooms using liquid composts.	31,724
Dr. M.L. Winston SFU, Biological Sciences	Development of a honeybee package and queen industry in British Columbia.	37,250
B. Aquatic Sciences		
Dr. L.D. Druehl SFU, Biological Sciences	The development of an edible kelp culture technology for British Columbia.	58,000
Mr. G.K. Davidson & Dr. R.N. O'Brien Applied Electrostatics Ltd., and Retech Ltd., Victoria, B.C.	Research into electrostatics applied to to smoking B.C. salmon.	135,350
Dr. B.J. Harvey & Dr. M. Ashwood-Smith UVIC, Biology	Development of a method for the supercooled storage of salmonid eggs.	11,000
Dr. J.B. Marliave Tidal Rush Marine Farms Nelson Island, B.C.	Use of tidal power for culturing pink and chum salmon fry.	15,000
Mr. R.G. Saunders Canadian Benthic Ltd. Bamfield, B.C.	The development of an intensive shellfish rearing system.	91,000
Dr. B.E. March UBC, Poultry Sciences	The feasibility of genetic selection of chinook salmon for uniform flesh pigmentation.	31,000

C. Electronics and Communications

Grant Recipient & Organization	Project Description	Awarded
Dr. R.F. Hobson SFU, Computing Science	To design and implement an interpreter 'building block' integrated circuit for multi-processor experiments.	67,960
Mr. D.S. Sloan Planetec Systems Inc., North Van., B.C.	Further development of the Planetec Planetarium Control System	65,000
Dr. M. Burbank CTF Systems Inc. Port Coquitlam, B.C.	Supplementary grant — Development of Squid Biogradiometer	15,000
Dr. H. Weinberg SFU, Psychology	Further development of a scanning third-order SQUID Biogradiometer for research and clinical applications.	20,500
D. Energy		
Dr. K. Colbow SFU, Physics	Cadmium selenide and Cadmium sulphide electrochemical solar cells.	29,700
Dr. R.R. Parsons UBC, Physics	Production-size Planar Magnetron Sputtering System for fabricating selective solar coatings.	51,700
Dr. J. Stiles Moli Energy Ltd. Burnaby, B.C.	A study of the growth & dissolution of lithium deposits in lithium batteries.	77,600
E. Forests and Forest Products		
Dr. J.E. Aune MacMillan Bloedel Reasearch Ltd. Vancouver, B.C.	Rock detection in logs.	17,000
Dr. J.D. Barrett Forintek Canada Vancouver, B.C.	Bending strength and stiffness of Douglas-fir dimension lumber from the future forests.	49,894
Dr. J.H. Borden SFU, Biological Sciences	Management of the mountain pine beetle with semiochemicals.	24,404
Mr. B. Dillistone Maple Ridge, B.C.	Tree management with the Weedo system.	29,225
Dr. R.M. Kellogg Forintek Canada Corp. Vancouver, B.C.	Development of a rapid field method for estimating tree wood density.	33,461

E. Forests and Forest Products (continued)

Grant Recipient & Organization	Project Description	Awarded
Dr. P.D. Lawrence UBC, Electrical Eng.	Log scaling by computer image processing.	4,500
Mr. W.C. Leith Trail, B.C.	Improved refiner plate design to reduce energy and improved loadability in rotating disc wood refiners (TMP).	79,700
Dr. P.A. Murtha UBC, Forestry	Remote sensing for early warning of incipient insect attack using multi-temporal data.	64,950
Mr. D.W. Ormerod Victoria, B.C.	Diameter point taper system.	8,000
Dr. K.L. Pinder UBC, Chemical Eng.	Elimination of the recausticizing step in pulp mills.	13,850
F. Manufacturing		
Dr. F.L. Curzon UBC, Physics	High power alternating current arc lamp.	48,000
Dr. D.G. Kilburn UBC, Dept of Microbiology	Production of human immune interferon and helper factor.	9,000
Dr. B.D. Pate UBC, Pharmaceutical Sciences & TRIUMF	Novel radiolabelling techniques of general applicability in radio-pharmaceutical production.	45,000
Dr. E. Teghtsoonian UBC, Metallurgical Engineering	Mechanical properties of hybrid composites.	36,800
G. Mining, Minerals and Metals		
Dr. R.W. Lawrence & Mr. A. Bruynesteyn B.C. Research Vancouver, B.C.	Microbiological processing of chalcopyrite and other nonferrous mineral concentrates.	65,000
Dr. A. Mitchell UBC, Metallurgical Engineering	Wear-resistant surfacing of mining components.	25,164
Dr. G. Poling UBC, Mining & Mineral Process Engineering	To conduct a research program in cooperation with Cominco Ltd., investigating alternative methods for fine cassiterite (tin) recovery at the Sullivan Concentrator.	35,500

H. Transportation

Grant Recipient & Organizaiton	Project Description	Awarded
Dr. S.M. Calisal UBC, Mechanical Engineering	Dynamic stability of small vessels.	29,500
	TOTAL (36 projects) Awarded	1,457,432

Research Grant Competition #7 (RC-7)

A. Agriculture and Food

Dr. J.E. Rahe Simon Fraser University Dept. of Bio. Sciences	Development of White Rot-resistant Commercial Onion Cultivars.	22,826
Mr. A. MacKenzie Dome Greenhouses Ltd. Surrey, B.C.	Microprocessor based greenhouse control system	41,500
Dr. N.R. Bulley University of B.C. Dept. of Bio-resource Engrg.	Feasibility study of horticultural illumination with prism light guides.	43,000
Dr. J. Levy & Dr. J.C. Brown Quadra Logic Tech. Inc.Dr. J.C. Brown Vancouver, B.C.	Development of monoclonal antibodies to bovine leukosis virus and the production of kits for the diagnosis of infections in herds of cattle.	28,000
Dr. D.S. Mavinic University of B.C. Dept. of Civil Eng.	Aerobic sludge digestion with lime addition — pilot plant study.	50,000
Dr. W.K. Oldham University of B.C. Dept. of Civil Eng.	Maximization of biological phosphorus removal from sewage using volatile fatty acids.	50,000

B. Aquatic Sciences

Dr. D. Green Seakem Oceanography Ltd., Sidney, B.C.	Development of a microprocessor-controlled *in situ* water sampler.	43,700
Dr. P. Fankboner Simon Fraser University, Dept. of Bio Sciences	Growth, recruitment and development in the commercial sea cucumber *Parastichopus californicus*	8,000
Dr. T. Owen Helix Biotech Ltd. Richmond, B.C. & Mr. M. Gordon B.C. Research, Vancovuer, B.C.	A simple, rapid technique for sex determination of maturing salmonids.	55,000

B. Aquatic Sciences (continued)

Grant Recipient & Organization	Project Description	Awarded
Mr. N. Gibbons Redonda Sea Farms Ltd., Refuge Cove, B.C.	Applied research to maximize the setting of oyster larvae on artificial cultch and applied research to nurse oyster spat on artificial cultch for single culture and suspended pipe culture.	80,000
Mr. B. Emmett Archipelago Marine Research, Victoria, B.C.	Biochemical analysis of summer mortality in cultured mussels (*Mytilus edulis*).	50,000
Dr. R. Foreman Bamfield Marine Station, Bamfield, B.C.	Phycocolloid production by B.C. seaweeds.	42,000
Mrs. M.D. Huynh B.C. Research Vancouver, B.C.	Sujiko production technology and quality for the Japanese export market.	45,000
C. Electronics & Communications		
Dr. L. Young University of B.C. Dept. of Elec. Engrg.	Gallium Arsenide device technology.	35,928
Drs. D. Goodman & J. Dickson Simon Fraser University Dept. of Kinesiology & Mr. M. Francas Microtel Pacific Research Burnaby, B.C.	A human factors study of components of the Telidon system.	31,770
Dr. S. Gygax Simon Fraser University Dept. of Physics	Development of a small refrigerator to enable the widespread use of of super-conducting electronics.	65,200
Dr. David Kirkpatrick & Mr. J.Walsh University of B.C. Dept of Computer Sci.	Audible Simulation of auditorium acoustics.	26,845
Dr. M. Burbank CTF Systems Inc. Port Coquitlam, B.C.	Development & use of a computerized SQUID scanning system for localization of current sources and foci in the brain.	125,000
Dr. H. Weinberg Simon Fraser University Dept. of Psychology	Same as above	42,690

C. Electronics & Communications (continued)

Grant Recipient & Organization	Project Description	Awarded
Dr. F. Consadori Newtec Ind. Ltd. Burnaby, B.C.	Investigation of semiconductor gas sensors aimed at the development of new devices and improved techniques in the design of low cost gas analysis systems.	65,000
Dr. R. Morrison Simon Fraser University Dept. of Physics	Same as above	30,000
D. Energy		
Dr. R. Morrison Simon Fraser University Dept. of Physics	The development of effective, low cost, solar windows for homes.	13,000
Drs. Paul Watkinson, John Grace & Norman Epstein, University of B.C. Dept. of Chem. Engrg.	Liquid fuels from coal by spouted bed pyrolysis.	18,600
Dr. R. Haering University of B.C. Dept. of Physics	Battery research.	12,500
Dr. M. Clements University of Victoria Dept. of Physics	A continued investigation into the ignition characteristics of methane with emphasis on implications to natural gas fuelled vehicles.	47,555
Drs. L. Young & H. Dommel University of B.C. Dept. of Elect. Engrg.	Integrated optic voltage sensor.	33,750
Dr. D. Sheraton B.C. Research Vancouver, B.C.	The development of hardware to operate diesel engines on natural gas.	76,724
Mr. F.E. Kellogg B.C. Research Vancouver, B.C.	Development of microprocessor-based control system for solar domestic hot water (DHW) systems.	35,000
Dr. M.D. Lefcort Heuristic Eng. Inc. Vancouver, B.C.	Development of a small (less than 10 M BTU/hr), two-stage gasifier capable of gasifying wet, dirty hog fuel, with continuous ash removal.	114,046

E. Forest & Forest Products

Grant Recipient & Organization	Project Description	Awarded
Dr. K. Klinka University of B.C. Faculty of Forestry	Rehabilitation of the Douglas-fir plantations in the Vancouver Forest Region featuring distorted growth.	59,600
Mr. Chang Lim Windsor Machine Co. Ltd., Langley, B.C.	Noise and vibration reduction on chain saw cutting attachment.	71,211
Dr. Gordon Weetman University of B.C. Faculty of of Forestry	Forest fertilization research in B.C.	75,000
Dr. D.M. Mackie MacMillan Bloedel Research, Vancouver, B.C.	Cedar mechanical pulp in newsprint.	135,419
Mr. Jan Brdicko Mitten & Associates Vancouver, B.C.	Development of circular saw thermal tensioning guides (CSTTG) Phase II.	102,400
Mr. K.K. Lau MacMillan Bloedel Research Vancouver, B.C.	Detection and control of sawing variation with bandsaws.	62,990
Dr. J.F.G. Mackay Forintek Canada Corp. Vancouver, B.C.	Accelerated drying of British Columbia framing lumber.	34,658
Dr. G. Puritch Safer Agro-Chem Ltd. Victoria, B.C.	Development of fungicidal fatty acid compounds and fatty acid — benzimidazole mixtures for the control fungal pathogens.	70,000
Dr. J.H. Bassman University of B.C. Faculty of Forestry	Ecophysiological studies of forest regeneration problems in the interior of B.C.	38,370
Mr. A. Sinclair F.E.R.I.C. Vancouver, B.C.	The economics of utilizing decadent interior Cedar and Hemlock.	19,550
Drs. L. Weiler, J.A. MacLean & A. Meisen University of B.C., Depts. of Chemistry, Forestry and Chemical Engrg.	Use of pheromones to control insects pests in British Columbia.	48,225
Dr. Paul R. Thomas Econotech Services Ltd. New Westminster, B.C.	Utilization of beetle-killed wood by the British Columbia pulp and paper industry.	46,650

E. Forest and Forest Products (continued)

Grant Recipient & Organization	Project Description	Awarded
Dr. P.R. Steiner Forintek Canada Co. Vancouver, B.C.	Modified plywood synthetic patch materials.	19,207
Mr. D.E. Rickson Canadian Forest Products Ltd., Vancouver, B.C.	Propagation of Douglas-fir, White Spruce, Lodgepole Pine and Yellow Cedar plantlets using tissue culturing techniques.	80,000
Dr. T.A. Black University of B.C. Dept. of Soil Science	The development of an instrument for the measurement of the rate of water loss by seedlings.	20,570
Mr. G. Stewart Porter Engr'g. Ltd. Richmond, B.C.	A computer vision system for defect detection in veneer and plywood.	90,140
Dr. James K. Turnbull MacMillan Bloedel Research Vancouver, B.C.	Value added products from alkaline sulfite pulping of cedar.	105,490
Mr. G.S. Porritt Windsor Machine Co. Ltd. Langley, B.C.	Developing improved saw chains for mechanical fellers.	65,250
Mr. A.V. Parasin Council of Forest Ind. of B.C. North Vancouver, B.C.	Strength evaluation of plywood from fast-grown trees.	36,800
Dr. L.C. Palka Forintek Canada Corp. Vancouver, B.C.	Effect of Wood density on truss-plate joint strength.	15,920
Mr. G.J. Esplin B.C. Research, Vancouver, B.C.	Development of novel colour removal process for kraft mill effluents.	99,210
F. Manufacturing		
Dr. Colin Oloman University of B.C. Dept. of Chem. Engrg.	Improvement of lubricant dispenser.	37,200
Dr. Ian Warren Chemetics Intl. Co., Vancouver, B.C.	Development of more efficient electrolytic chlorate production cell.	80,000
Dr. D.M. Camm Vortek Industries Ltd., Vancouver, B.C.	Development of a light source for the resource industries in British Columbia.	100,585

Grant Recipient & Organization	Project Description	Awarded
Mr. G.M. North Techwest Enterprises Ltd. Mr. J.S. Vincent, TRIUMF Dr. D.M. Lyster, VGH Vancouver, B.C.	Development of a prototype Xenon 127 Recovery Machine for clinical use in diagnostic nuclear medicine.	58,580
Mr. R. Breckner Innovac Technology Inc. Richmond, B.C.	Fish and food pump.	79,200
Dr. J.L. Richardson Seagold Inc. Corp., Burnaby, B.C.	Desalination by solar photovoltaic power.	50,000
G. Mining, Minerals & Metals		
Mr. C.O. Brawner University of B.C. Dept. of Mining & Min.	Development of a correlation between blast hole drilling rate, rock quality index and powder factor to blasting costs on mining projects.	21,500
Drs. G.H.N. Towers & H.V. Warren University of B.C. Depts. of Botany of Botany and Geo. Sciences	Exploiting the potential of the Southern Pinchi Fault in a search for new gold, copper, and mercury mines.	26,560
Dr. Ian Warren Chemetics Intl. Company Vancouver, B.C.	Continuous electrolyte analysers — Stage II	72,000
Dr. Alan Reed University of B.C. Dept. of Mining & Min. Process Eng.	Economic evaluation of coal transportation by an underground gravity/slurry flow system as an alternative to truck haulage at Byron Creek Collieries Ltd., Coal Mountain, B.C.	20,000
H. Transportation		
None		
	Total (60 projects) Award	**$3,174,919**

Awards

G.R.E.A.T. Scholarships Awarded 1982-83

1. Extension of GC-1 Award

Name of Student	University & Department	Name of Academic Supervisor	Cooperating Organization
Brenda Burd	Biology, UVic	Dr. R.O. Brinkhurst	Dobrocky Seatech Sidney, B.C.

Supplementary G.R.E.A.T. Award Competition (GC-2)

New Awards

Name of Student	University & Department	Name of Academic Supervisor	Cooperating Organization
B.Y.P. Fung	Clinical Engineering UBC	Dr. C.A. Laszlo	Biomedical Engineering Dept. Vancouver General Hospital Vancouver, B.C.
C. Forster	Geological Sciences UBC	Dr. L. Smith	Nevin Sadlier-Brown Goodbrand Ltd. Vancouver, B.C.
J.J. Aota	Metallurgy, UBC	Dr. A.C.D. Chaklader	Clayburn Industries Ltd. Abbotsford, B.C.
Jim Clark	Electrical Engineering UBC	Dr. P.D. Lawrence	Forest Engineering Research Institute of Canada Vancouver, B.C.
Hae-Yong Shin	Oceanography, UBC	Dr. W.J. Emery	MacDonald Dettwiler & Associates Ltd. Richmond, B.C.
Neil B. Cox	Electrical Engineering UBC	Dr. M.R. Ito & Dr. J.A. McEwen	Vancouver General Hospital Biomedical Engineering Dept. Vancouver, B.C.
Donald J. White	Geophysics & Astronomy, UBC	Dr. R.M. Clowes	Great Western Petroleum Corp. Vancouver, B.C.
C.G. Saunders	Electrical Engineering UBC	Dr. M.R. Ito	Medical Engineering Resource Unit Shaughessy Hospital Vancouver, B.C.

Name of Student	University & Department	Name of Academic Supervisor	Cooperating Organization
A. Colangeli	Biology, UVIC	Dr. J.N. Owens	Western Forest Products Lost Lake Seed Orchard Victoria, B.C.
F.E. Williams	Biological Sciences SFU	Dr. R.A. Robinson	Pacific Forest Products Ltd. Saanichton, B.C.
Hans H. Fellenz	Faculty of Forestry UBC	Dr. R. Kennedy	Forintek Canada Corp. Vancouver, B.C.
J. Joseph Churcher	Faculty of Forestry UBC	Dr. J.A. McLean	B.C. Forest Service Victoria, B.C. & Prince George, B.C.
Brian E. Chapel	Geophysics & Astronomy, UBC	Dr. T. Watanabe	B.C. Hydro Research & Development Surrey, B.C.
Christine Cook	Biology, UVIC	Dr. R.D. Burke	Canadian Benthic Ltd. Bamfield, B.C.
Marie M. Roussey	Metallurgical Eng. UBC	Dr. F. Weinberg	Cominco Ltd. Trail, B.C.
Gordon Cheng	Electrical Eng., UBC	Drs. L. Young, P. Lawrence & G. Schrack	Microtel Pacific Research Burnaby, B.C.
Joanne M. Lawrence	Biology, UBC	Dr. Marcus A.M. Bell	B.C. Coal Ltd. Sparwood, B.C.
Leonard J. Zedel	Dr. H.W. Dosso, Physics, UVIC		Institue of Ocean Sci.
A. Banner	Forest Resource Management, UBC	Dr. Peter A. Murtha	Integrated Resources Photography Ltd. Vancouver, B.C.
Irina Ostrovsky	Biology, UVIC	Dr. Derek V. Ellis	MacMillan Bloedel Ltd. Nanaimo, B.C.
Michael McGurk	Animal Res. Ecology UBC	Dr. N.J. Wilimovsky	Bamfield Marine Station Bamfield, B.C.
Mark Jaccard	Natural Resource Management, SFU	Dr. T.I. Gunton	B.C. Ministry of Energy, Mines & Petroleum Resources Victoria, B.C.
Wayne D. Temple	Soil Science, UBC	Dr. A.A. Bomke	Reynelda Farms Delta, B.C.
Jennifer Sherlock	Plant Science, UBC	Dr. Roy L. Taylor	Reid, Collins Nurseries Ltd. Aldergrove, B.C.

Science Council of B.C. G.R.E.A.T. Award Competition (GC-3)

1. New Awards

Name of Student	University & Department	Name of Academic Supervisor	Cooperating Organization
Clinton R. Smyth	Dept. of Biology UVIC	Dr. M.A.M. Bell	Fording Coal Ltd. Elkford, B.C. B.C. Coal Ltd. Sparwood, B.C. Crowsnest Resources Ltd. Sparwood, B.C.
Richard D. Kabzems	Faculty of Forestry UBC	Dr. K. Klinka	Western Ecological Services (B.C.) Ltd. Sidney, B.C. Ministry of Forests Burnaby, B.C.
James S. Hackett	Faculty of Forestry UBC	Dr. P.H. Pearse	British Columbia Forest Products Ltd. Vancouver, B.C.
Stephen W. Taylor	Forest Sciences Dept. UBC	Dr. M.C. Feller	B.C. Ministry of Forests Smithers, B.C.
Nancy Richardson	Animal Science Dept. UBC	Dr. R.M. Beames	Fisheries Research Branch Fisheries & Oceans Canada West Vancouver, B.C.
R. Raudsepp	Dept. of Metallurgical Engineering, UBC	Dr. E. Peters	Bacon, Donaldson & Associates Ltd. Vancouver, B.C.
Clinton Fong	Dept. of Metallurgical Engineering, UBC	Dr. D. Tromans	MacMillan Bloedel Research Vancouver, B.C.
Reed A. Radley	Dept. of Plant Science UBC	Dr. F.B. Holl	D. Amoore Holdings Inc. West Vancouver, B.C.
William A. Price	Dept. of Soil Science UBC	Dr. L.M. Lavkulich	Amax of Canada Ltd. Vancouver, B.C.
William Cochlan	Dept. of Botany/ Oceanography, UBC	Dr. P.J. Harrison	Inst. of Ocean Sciences Sidney, B.C.
Barry Shell	Dept. of Bio-Resource Engineering, UBC	Dr. L.M. Staley	B.C. Hydro Energy Use Engineering Dept., Vancouver, B.C.

Name of Student	University & Department	Name of Academic Supervisor	Cooperating Organization
Francisco M.G.A. Salgado	Civil Engineering Dept., UBC	Dr. P.M. Byrne	Golder Associates Consulting Geotechnical & Mining Engineers Vancouver, B.C.
Philip G. Comeau	Forest Sciences Dept., UBC	Dr. J.P. Kimmins	Crestbrook Forest Industries, Cranbrook, B.C.
Greg Crawford	Dept. of Physics, UVIC	Dr. J.T. Weaver	Inst. of Ocean Sciences Sidney, B.C.
Kenneth De Graaf	Metallurgical Engineering Dept. UBC	Dr. E. Peters	Cominco Ltd. Trail, B.C.
Wilf Luedke	Inst. of Animal Resource Ecology, UBC	Dr. R. Hilborn	Fisheries Assoc. of B.C. Vancouver, B.C.
Michael J. Stanhope	Biological Sciences Dept., SFU	Dr. B. Hartwick	MacMillan Bloedel Ltd. Nanaimo, B.C.
Bruce Lehmann	Dept. of Mechanical Engineering, UBC	Dr. S.G. Hutton	Kockums Industries Ltd. Surrey, B.C.
Sandra M. O'Neill	Inst. of Animal Resource Ecology, UBC	Dr. C.C. Lindsey	Pacific Biological Station Nanaimo, B.C.
Kenneth Ling-Man Chan	Dept. of Electrical Engineering, UBC	Dr. P.D. Lawrence & Dr. J.A. McEwen	Biomedical Engineering, Vancouver General Hospital Vancouver, B.C.
Julie E. Brooks	Dept. of Biological Sciences, SFU	Dr. J.H. Borden	B.C. Forest Service Burnaby, B.C.
Howard Thistlewood	Biological Sciences Dept., SFU	Dr. J.H. Borden	Summerland Research Station Summerland, B.C.
Donald G. Gillespie	Civil Engineering Dept., UBC	Dr. R.G. Campanella	Thurber Consultants Ltd. Vancouver, B.C.
Carleen M. Gibson	Dept. of Animal Science, UBC	Dr. D.M. Shackleton	B.C. Coal, Environmental Services Dept. Sparwood, B.C.

Name of Student	University & Department	Name of Academic Supervisor	Cooperating Organization
Cynthia D. Scott	Biological Sciences Dept., SFU	Dr. M.L. Winston	Okanagan Valley Pollination Association Vernon, B.C.
Robert J. Stephenson	Dept. of Bio-Research Engineering, UBC	Dr. K. Victor Lo	Envirocon Ltd. Vancouver, B.C.
Laura Taylor	Dept. of Biology, UVIC	Dr. D.V. Ellis	Island Copper Mine Ltd. Port Hardy, B.C.

Industrial Post Doctoral Fellowships Awarded 1982-83

1. New Awards

Award Recipient	Employing Company
Dr. J.B. Peters	Nexus Engineering Corporation, 4181 McDonnell Drive, Burnaby, B.C. V5A 3J7

2. Renewal Awards

Award Recipient	Employing Company
Dr. R.S.H. Lee	Data Tech. Systems Ltd., 1095 McKenzie Ave., Victoria, B.C.
Dr. M.E. Bakker	Seakem Oceanography, 2045 Mills Road, Sidney, B.C.

B.C. Health Care Research Foundation Awards — 1982

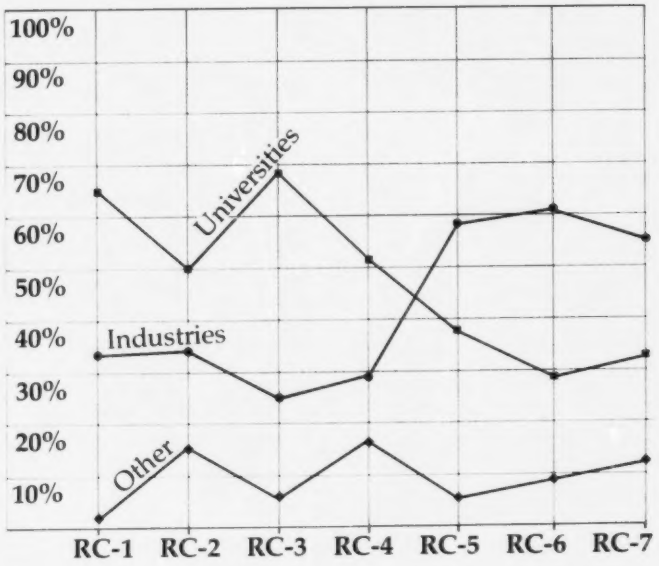
Category	No. of Awards	$ Value
Competition Deadline March 1, 1982		
Demonstration and Evaluation	5	116,448
Clinical	22	497,700
Basic Science	29	648,490
Research Scholar	7	257,100
Development and Training Fellowship	2	25,060
Sub Total:	65	1,544,798
Competition Deadline October 1, 1982		
Demonstration and Evaluation	5	113,600
Clinical	28	723,737
Basic Science	34	683,312
Research Scholar	3	102,400
Development and Training Fellowship	2	64,000
Sub Total:	72	1,687,049
Emergency Grants	14	80,983
Total (1982)	151	3,312,830

Funds

Summary of R & D Performance in B.C. (1973 - 1982) ($ Millions)

R & D PERFORMER (Source of Data)	73/74	75/76	77/78	79/80	80/81	81/82
Federal Gov't. Intramural Natural Science Current Expend. (Statistics Canada)	35.0	44.1	55.8	66.0	65.0	67.3
Industry Intramural Current Expend. (Statistics Canada)	14.0	25.8	31.9	43.0	61.0	73.0
Universities Research grants and contracts (Res. Secretariat & U.C.B.C.)	18.3	19.3	25.6	38.5	48.6	56.9
B.C. Gov't. Intramural current Natural & Social Sciences (Statistics Canada)	3.1	3.9	4.9	8.0	13.1	13.5
B.C. Research Council (Statistics Canada & Annual Reports)	1.4	1.8	2.6	2.6	3.9	4.4
TOTAL	71.8	94.9	120.8	158.1	191.6	215.1

Distribution of Science Council Research Funds to Universities and Industries by Percentage



A Research & Development Policy For British Columbia In The 1980's

The Present Situation

The economy of British Columbia is heavily dependent on such natural resource industries as Forestry, Mining, Agriculture and Fishing. The primary and related processing sectors contribute 40% of the province's Gross Domestic Product. The services sector relies almost exclusively on the resource industries for its business.

It is clear from the present economic situation that the province's resource industries are vulnerable to many outside factors, and that these factors produce a history of both growth and recession. Many are beyond local control, responding to world demand and market prices. Others, however, originate in British Columbia: industrial efficiency, raw material costs, labour availability and cost, and government regulation.

A key factor in efforts to increase industrial growth and efficiency in the province is the degree to which TECHNOLOGY can be applied. Such application can only occur with a healthy program of scientific and engineering research and development.

The present level of research and development activity in British Columbia is embarrassingly low! At the same time as the government of Canada has implemented a policy of raising the national level of research and development from 1.0% of Gross National Product in 1979 to 1.5% in 1985, the comparable figure for British Columbia is 0.6%. That percentage puts this province in the same league as Iceland (0.7%) and Ireland (0.8%) but well behind Finland (1.1%), Norway (1.4%) and Australia (1.0%).

A Change of Direction

The Science Council of British Columbia urges the Government to take immediate steps to improve the situation. The Government is looking for ways to make the provincial economy less susceptible to the ebb and flow of international demand for our raw materials and industrial commodities. SCIENCE AND TECHNOLOGY can stimulate the economy by improving the competitive position and profitability of existing industries and by encouraging the expansion of industry into new areas.

It can only do this, however, if support and encouragement are given to industries, research institutes and Government departments. Furthermore, these agencies must cooperate in the development and application of new technology. The potential benefits of increased scientific and research activity are three-fold:

1) It will tend to attract and give rise to *new, high-technology businesses* which rely on expertise and knowledge, rather than cheap raw materials or labour. Such industries tend to be affected less by the cyclical nature of the primary resource industries, they can provide unusually high rates of growth, and they are less affected by geographical limitations than traditional heavy manufacturing. Also, they can be *environmentally compatible with urban locations* and can *provide employment for many highly trained British Columbians* who must now leave the province to find suitable work.
2) It will lead to the development of *new products and processes* that use the province's raw materials. This has the benefit of creating greater employment and economic activity in the secondary manufacturing and service industries.

3) It will lead to an *improved technical and scientific awareness* which can, in turn, contribute to increased efficiency and productivity in the primary resource industries on which we will continue to depend.

High technology success stories are not restricted to Japan, the United States and certain Western European countries. Here, in British Columbia, there are glowing examples of the potential of high technology. For example, MacDonald, Dettwiler and Associates, an electronics firm based in Richmond, is a world leader in its field. The company started as a small two-man operation in 1969 and, just twelve years later, in 1981, employed over two hundred people and had annual sales (80% for export) in excess of $14 million. Cominco Ltd., at its Trail Electronic Materials Division, with its gallium arsenide substrate for microwave integrated circuitry; and CTF Systems Inc. of Port Coquitlam with its SQUID magnetometers and associated computerized scanning systems, are two further examples.

(Note: Studies by the General Electric Company into the factors affecting economic growth in the United States have produced some interesting results:

*a) High technology industries **grow almost three times as fast** as low technology ones.*

b) Productivity, measured as output per employee in a high technology industry was twice that experienced in low technology.

*c) In the United States, employment in high technology industries has been **growing almost nine times faster** than in low technology ones. This is due in part to the fact that the high technology industries are usually new and small, and therefore grow faster than mature companies.)*

Recommendations

1. **Increase support for Research and Innovation**

   a) *Increase Science Council of B.C. grants* in support of Research and Development projects of economic importance to the province to an annual level of $7 million (1982 dollars). (1981-82 funding $5.5 million, 1982-83 funding $3.8 million.) Recommendation: $7 million per year.

   b) *Increase support for health care and medical research* through the B.C. Health Care Research Foundation. (Present funding level is $2.7 million per year, from the Lotteries Fund.) Recommendation: $5 million per year.

   c) *Increase support for the Core Research Program of B.C. Research* in areas of provincial importance. Recommendation: $5 million per year.

   d) *Low Interest Loans* — Another alternative for encouraging the development and implementation of new technology in the province is a program of *government-sponsored low interest loans*, similar to the program supported by the Federal Business Development Bank. It must be appreciated that in most instances R and D expenses account for only a small fraction of the costs associated with the exploitation of an innovation. Low interest loans *would help bridge the financial gap between research and commercial production*. Recommendation: guarantee the bank prime rate to those worthy applicants.

2. **Improve Environment for Business Activity and Investment**

   In financial terms, innovation is a risky business. On average only about 10% of R and D projects are economically successful and finding venture capital is a common problem for innovators. The current recession and simultaneous curtailment of much R and D activity has made it clear that incentives are required to generate sources of venture capital. The *Government* of British Columbia *should encourage potential investors to consider research and scientific innovation as a good investment opportunity*. Some measures which could be implemented could be based on the following federal programs:

   a) Encourage research activities through *appropriate tax measures*. Consider extension of existing Federal tax measures to provincial taxes, permitting a similar deduction.

b) *Institute a "Negative Income Tax"*

In normal times, credits against income tax represent a powerful and effective motivation for research and development expenditures. However, the current net loss position of many Canadian companies has reduced the number who are able to take advantage of tax write-offs. In some cases, the tax incentives from R and D may not be applicable for several years to come.

An alternative which may be appropriate *in terms of low profitability* and for newly-formed companies would be the introduction of a "negative income tax". Through this, Canadian *companies* performing research and development *would have the option of claiming a cash advance from the government equal to the savings the taxpayer* would have been able to claim in a year of normal profitable operation.

c) Encourage Research and Development activities by the *promotion of "limited partnership" arrangements*.

In an attempt to improve the risk/return ratio of investment in R & D, the federal government has instituted a program of federal tax incentives to encourage the formation of *limited partnerships*. Entrepreneurs can use these partnerships to raise capital for research and development work. Investors are then eligible for a wide range of tax deductions (currently under review by the Federal Government).

d) *Provincial Sales Tax*

Sales taxes on equipment, materials and instrumentation destined for research and development activities should be removed. While this action would in the short-term reduce provincial revenues, in the *long-term, benefits accruing to the province from increased industrial activity should more than compensate*. ($3 million per year is the estimated early loss of revenue.)

e) *Government Regulations Affecting R & D*

The decision to conduct R & D or to innovate rests ultimately with industry itself. Consequently, *the government's role* in the innovation process *should be limited to creating suitable conditions and providing appropriate assistance*.

In order to foster an investment climate which is favourable to R & D innovation, the federal and provincial governments should examine their respective regulatory systems to ensure that they do not inhibit business. *Restrictive legislation governing mergers, investment, competition and market share should be reviewed* to determine their effectiveness, and modified where appropriate. For example, clear guidelines from the F.I.R.A. for R & D type takeovers would be useful.

3. **Promote Research of Importance to the Province**

Government programs in support of research and scientific activities should: (i) promote areas with an *economic or social benefit* to the province, and (ii) promote areas where there is an *existing base of expertise and "know-how"*.

It is important to build on areas of existing local expertise and emphasize research which can provide a high added value to our natural resources. The following sectors have been identified as meriting increased research activity (in alphabetical order):

a) *Agriculture and Food* — Plant genetics, hydroponics, greenhouse technology, and biological control systems are a few of the R & D areas which could help reduce our dependence on imported foodstuffs.

b) *Aquatic Sciences and Mariculture* — To take advantage of the 200 mile limit and fully exploit the production potential of the province's water resources much R & D is required. Ocean engineering is an important related field.

c) *Biotechnology and Bioengineering* — There is considerable local expertise in this rapidly expanding field and the potential applications are extremely varied — from pharmaceuticals, biomass energy to microbiological leaching of mineral ores.

d) *Computer software and technology* — Process control, and CAD/CAM are two aspects which warrant research support.

e) *Electronics and Communications* — Telecommunications, earth surveillance and electronic remote sensing for forestry, agriculture, mineral exploration etc., are important areas of local expertise. The province's high technology industries should receive encouragement to further their competitiveness, especially in export markets.

f) *Energy* — Energy research is, at present, heavily funded in most developed countries in an attempt to find substitutes for non-renewable and increasingly expensive oil and natural gas supplies. British Columbia has no unique energy problems requiring specialized forms of research, but should encourage the efficient utilization of its natural gas and hydroelectric resources, exploration for geothermal sites, and maintain a high level of knowledge regarding cumbustion, coking, gasification and liquefaction of coal. Also British Columbia could become a centre of expertise in the use of biomass as a renewable energy resource.

g) *Environment* — Environmental research has important social impacts and may have implications for economic development. A reasonable balance between these two objectives is required. Environmental and industrial health legislation pending in Canada, U.S.A., and Europe shows that the development of standards and controls to ensure safe working conditions and safe transportation and disposal of chemicals and waste products will be the responsibility of government.

h) *Forestry and Forest Products* — A review of spending in this sector indicates that R & D activities are extremely low relative to its importance in the economy of the province, particularly in silviculture and other areas of forest preservation and improvement.

i) *Health Care* — British Columbia has a strong and varied medical research community. For example, the facilities at the UBC Acute Care Hospital, other affiliated teaching hospitals, and TRIUMF, permit research into advanced diagnostic techniques, including nuclear medicine.

j) *Manufacturing* — Much research is needed to improve the effectiveness of our existing manufacturing industry by means of improved productivity, to increase the value-added component of our forest products and mineral processing industries, and to attract so-called "foot-loose" industries.

k) *Mining and Mineral Processing* — British Columbia already has considerable expertise in mining, mineral processing and metals. Research in such areas of biotechnology, electrolysis and electrowinning would open up further opportunities in mineral technology.

l) *Transportation* — Research is urgently needed to solve transportation problems related to economic development and our urban social structure.

4. **Train Scientific and Technical Manpower**

a) The government should increase support for programs aimed at the training of highly qualified manpower for employment in local industry. The Science Council's Graduate Research in Engineering and Technology (G.R.E.A.T.) awards and Industrial Postdoctoral Fellowships (IPDF) both assist in the support and training of research manpower for technology-based industry.

b) The province should ensure that there is an adequate supply of trained scientists and technologists and other skilled manpower required for future expansion of both primary and secondary industry. This requires support for the training of future engineers, scientists, technologists and technicians in the province's universities, colleges, institutes and pre-apprenticeship programs.

c) *Programs to encourage the employment of newly-qualified scientists and technicians in local industry should be expanded*. The Science Council's IPDF program is providing this support for researchers with Ph.D's, but the scope could be expanded to include other levels of scientists and technologists. This would encourage local industries to increase their scientific and technological capabilities and provide employment for young people from our post-secondary education system.

5. **Assist Innovators and New Business Ventures**

The Science Council of British Columbia recognizes the difficulties associated with taking an innovation from the laboratory to the marketplace, and has appointed an Innovation Coordinator, in cooperation with the Discovery Foundation, to assist entrepreneurs with this process. *The Innovation Office* will attempt:

a) *To encourage inventors and researchers to have their 'inventions' assessed for technical and economic feasibility, patentability and the desirability of further development;*

b) To assist in the *provision of technical expertise* essential for the successful product/process/system development from the stage provided by the inventor to a marketable stage;

c) To *bring together the inventors and the interested entrepreneurs* and to provide support and encouragement for the formation of manufacturing and marketing units, e.g., patent advice, incorporation advice, market studies, financing advice, etc.;

d) To provide the additional *management assistance* prerequisite to the formation and guidance of those small business organizations which play such a large role in industrial innovation;

e) *To seek or provide 'seed' money to invest in new ventures.*

Some additional government financing will be required.

6. **Use Government Policy to Support British Columbia Industry and Research**

a) Strengthen provincial government policy of *seeking local suppliers of scientific goods and services*. The scientific, technological and research needs of ministries, Crown corporations, regulated utilities and agencies should be contracted out to British Columbia industries, research institutes and universities, whenever possible to stimulate the development of local expertise.

Since 1973 the Science Centre of the Department of Supply and Services has been the central agency for the administration of scientific and research contracts under the federal contracting-out policy. During the year ending March 31, 1982 the Science Centre issued over 3,000 contracts valued in excess of $200 million. Of this total, over 550 contracts worth almost $30 million were awarded to British Columbia companies and researchers. Thus British Columbian scientists and engineers received 15% of the Federal funds available by this route. The provincial government should encourage and support British Columbia's scientific community in actively competing for Federal contracts and to make submissions to the parallel Unsolicited Proposal Program.

b) *International Sources*

The Defence Off-set Program of the Canadian and United States governments is an example of funding that is available for the provision of goods and services to foreign governments. Under this program $3.5 billion is available to off-set Canadian military purchases in the United States over the next ten years.
Efforts by the Ministry of Industry and Small Business Development to promote B.C. participation in this and other national and international programs should be continued.

7. **Support the Location of Major Scientific Facilities in British Columbia**

a) Research projects of national importance increase the technological resources of the local region in both skilled manpower and industrial capability. An example of this is the TRIUMF cyclotron. Among the present technical spin-offs produced by TRIUMF are:

Pion Cancer Therapy	Electronic Circuits & Control Technology	High Speed Data Handling
Radioactive Isotope Production	N/C Machining	
Positron Emission Tomography	High Vacuum Technology	

Other examples are the research facilities of Microtel Pacific Research, B.C. Hydro, Cominco, B.C. Research and the Institute of Ocean Sciences.

b) Location of the key installation of the National Research Council's *Long Baseline Array radiotelescope* system would provide similar spin-off benefits and opportunities for British Columbia's scientists and engineers.

c) *A computer-aided design and manufacturing (CAD/CAM) centre and a biotechnology research centre* are other projects of national importance which might be located in British Columbia.

Based on favourable cost-benefit analyses, the provincial government should be prepared to encourage the location in this province of such facilities, since these centres tend to draw funds from outside the province.

8. **Coordinate Government/University/Industry Research Activities**

a) *Programs* (e.g., Science Council grants, scholarships and fellowships) *which promote the collaboration* of the Province's university researchers with industry and government *should receive increased support*. In this way existing research expertise and facilities can be directed to problems of provincial importance.

b) *The Science Council and Research Secretariat* of British Columbia should act as the central bodies for the *coordination of policy and information* on the scientific and research activities being performed in British Columbia.

c) *The Internal Research Advisory Committee* (IRAC) should develop its role as a policy and review body for the Provincial Government's internal research activities, and maintain close liaison with the Science Council and Research Secretariat.

9. **Encourage Public Awareness of the Benefits of Science and Research**

The province should support initiatives aimed at improving public awareness of scientific and technological activities in British Columbia. This can take many forms from the establishment of science centres (e.g., the Planetarium, the Arts, Science & Technology Centre, the Aquarium and others throughout the province), support of public events (e.g. "Discovery Fair"), Science Council's Science and Engineering Gold Medals, to improved science education in the school system. Such programs should be aimed at the entire population, but special emphasis should be placed on reaching the young student who may not be aware of the opportunities available in British Columbia in science and technology.

10. **Provide Suitable Locations for Technology-Based Industry**

The province should undertake a vigorous promotional campaign to encourage entrepreneurs and "footloose industry" to establish in British Columbia. High technology industries, for example, can develop without a resource base in the region and, often, can compete more easily than primary industries in export markets. They depend more on innovative thinking, an adequate supply of venture funding and a pool of technological expertise. The products of high-technology industry are often ideas or devices which do not depend strongly on the proximity to markets but thrive, rather, where living conditions are congenial. British Columbia is potentially a very favourable location for such industries.

In 1979 the Provincial Government provided initial funds to create Discovery Parks, a series of Industrial research parks located near the three provincial universities and the British Columbia Institute of Technology. Discovery Parks' aim is to attract and assist the development of capital-intensive, high-technology industry and foster close links between industry and the neighbouring educational centres. The R & D parks should provide sites for scientists and technologists, and thus provide the 'magnet' and spin-off benefits of a concentration of innovative, knowledge-based industries.

11. **Support Cultural and Social Amenities**

It is recognized that the attractiveness of an employment opportunity is not now solely related to remuneration and perquisites. The nature of a community's cultural, sporting, recreational, and social amenities now bear strongly on a decision to locate (or not to locate) in a region. The potential of B.C. Place is a current example of the B.C. Government's recognition of this fact. Much more can be done, particularly in the support of such activities in centres throughout the province.

TABLE 1

Gross Expenditure on Research and Development as a percentage of Provincial Gross Domestic Product

	1979		1980	
Canada	2,669 / 269,321.4	= .99%	3,097 / 297,449.5	= 1.04%
B.C.	165 / 32,698.6	= .50%	203 / 36,507.3	= .55%
Alberta	262 / 34,542.5	= .76%	322 / 40,173.6	= .80%
Western Provinces	578 / 88,606.6	= .65%	712 / 100,827.5	= .71%
Quebec	586 / 61,760.6	= .94%	639 / 67,792.4	= .94%
Ontario	1,313 / 102,037.9	= 1.28%	1,569 / 111,739.6	= 1.40%
Atlantic Provinces	180 / 16,057	= 1.12%	161 / 16,167.2	= .99%

NOTE: 100x $\frac{\textit{Gross Expenditure on Research and Development (\$ Million)}}{\textit{Provincial Gross Domestic Product (\$ Million)}} = \%$

SOURCE: Science Statistics Centre, Statistics Canada.

TABLE 2

Gross Expenditure on Research and Development (GERD) as a Percentage by Performing and Funding Sector (1979)

	CANADA		BRITISH COLUMBIA	
	Funding Sector	**Performing Sector**	**Funding Sector**	**Performing Sector**
Federal	38.9 } 45.8	25.1	40.0 } 46.1	23.0
Provincial	6.9 }	3.6[1]	6.1 }	5.5[1]
Industry	35.8	44.2	27.3	32.7
University	13.9	25.9	21.2[2]	37.6
Other	4.4	0.8	5.4	.6

NOTES: 1. This includes Provincial Research Organizations.

2. Reported University funding for research is derived from general salary and administrative support, mostly from Provincial and Federal Sources.

SOURCE: Background Notes on R & D Policies, Planning and Programming for the Honourable John Roberts, Minister of State for Science and Technology and Minister of the Environment at a meeting at the Toronto Board of Trade, January 19, 1981.

TABLE 3

Current Intramural Spending on Research and Development by Industry: 1979[3]

	Intramural Spending[1] Millions of Dollars		Persons Engaged in R&D[2] Person-Years	
	B.C.	Canada	B.C.	Canada
Mines & Oil and gas wells	5	66	115	990
Chemical Based	1	206	50	4,925
Wood Based	14	46	315	1,190
Metals	3	80	51	1,875
Machinery & Transportation Equipment	5	261	90	5,700
Electrical	7	238	245	6,405
Other Manufacturing	—	11	4	335
Services	8	139	230	3,200
	43	1,047	1,100	24,620

[1] Statistics Canada. Science Statistics Centre. *Standard Industrial R&D Tables: 1972-1981*. Pg. 42 Table 20 "Current Intramural R&D Expenditures by Industry Group and by Region 1979."

[2] IBID. Pg. 49, Table 31. "Number of Persons Engaged in R&D by Industry Group and by Region, 1979."

[3] Exclusive of capital expenditures.

TABLE 4

Gross Expenditure on R&D as a Percentage of GNP for OECD Countries[1]
(N.B. 1979 unless otherwise indicated)

(1)	2.5%	U.S.A.	(11)	1.1%	Finland
(2)	2.4%	Germany	**(12)**	**1.0%**	**Canada (1.07%, 1981)[2]**
(3)	2.4%	Switzerland	(13)	1.0%	Australia
(4)	2.2%	U.K.	(14)	1.0%	Denmark
(5)	2.0%	Japan	(15)	0.8%	Ireland
(6)	2.0%	Netherlands	(16)	0.8%	Italy
(7)	1.9%	Sweden	(17)	0.7%	Iceland
(8)	1.8%	France	(18)	0.3%	Portugal (1978)
(9)	1.4%	Norway	(19)	0.2%	Greece
(10)	1.4%	Belgium			

SOURCE: (1) OECD Observer, *No. 115 March 1982, Page 26-7*

(2) Ministry of State for Science and Technology. Federal Scientific Activities: 1982/1983, *Ottawa: Supply and Services Canada, 1982. Page iv.*

TABLE 5

Indicators of Provincial Scientific Activities: Provincial Research Organizations

Province	Current expenditures on R & D 1980 (1) ($'000)	Rank
Nova Scotia	1,447	6
New Brunswick	1,150	7
Québec	8,212	3
Ontario	8,600	2
Manitoba	889	8
Saskatchewan	3,472	4
Alberta	12,079	1
British Columbia	2,542	5
Total	38,391	

SOURCE: (1) Science Statistics Vol. 5, No. 11, Statistics Canada Catalogue No. 13-003.

TABLE 6

Indicators of Provincial Scientific Activities: Universities

Province	Graduate student index, 1979-80(1)		Sponsored research in universities per capita, 1979-80(2)	
	(No.)	Rank	($)	Rank
Newfoundland	0.9	8	15.05	5
Prince Edward Island	—	10	—	10
Nova Scotia	2.0	3	13.75	7
New Brunswick	0.9	8	10.67	9
Québec	2.2	2	16.04	4
Ontario	2.3	1	18.89	2
Manitoba	2.0	3	22.69	1
Saskatchewan	1.1	7	17.01	3
Alberta	2.0	3	14.42	6
British Columbia	1.9	6	12.99	8
Canada	2.0		16.51	

(1) Graduate student index = number of full-time graduate students per 1,000 provincial population over the age of fifteen years.

(2) Sponsored research in universities per capita = total research money granted to universities ÷ provincial population.

SOURCES: Full-time enrolment for graduate degrees, per capita (15 and over) Universities Enrolment and Degrees, 1979-80, Statistics Canada Catalogue No. 81-204 and Estimates of Population by Sex and Age for Canada and the Provinces, June 1979, Statistics Canada Catalogue No. 91-202.

Financial Statistics of Universities and Colleges, 1979-80, Statistics Canada.

TABLE 7

Indicators of Provincial Scientific Activities: Industry

Province	Value added by manufacturing industry per capita, 1978 (1)		Current intramural industrial R & D expenditures *per employee* in primary and secondary industry, 1979 (2)	
	($)	Rank	($)	Rank
Newfoundland	662.1	8	16.00	9
Prince Edward Island	467.7	10	—	10
Nova Scotia	1,047.2	6	51.00	6
New Brunswick	1,040.9	7	29.00	8
Québec	2,212.7	2	330.00	2
Ontario	3,012.7	1	390.00	1
Manitoba	1,233.6	4	72.00	5
Saskatchewan	562.1	9	43.00	7
Alberta	1,141.2	5	279.00	3
British Columbia	2,022.2	3	117.00	4
Canada (3)	2,145.4		292.00	

SOURCE: (1) Manufacturing Industrries of Canada; National and Provincial Areas, 1978, Statistics Canada Catalogue No. 31-203.

(2) Results of 1979 Industrial R & D survey, Science Statistics Centre, Statistics Canada and The Labour Force, July, 1981, Statistics Canada Catalogue No. 71-001.

(3) Includes the Yukon and Northwest Territories.

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TABLE 8

Indicators of Provincial Scientific Activities: Federal Government

Province	Expenditures on intramural natural science activities 1979-80 (1)	Intramural manpower 1979-80 (1)	Contracts awarded by the Science Procurement Sector, Department of Supply and Services, 1980-81 (2)	
	($'000)	(Full-time equivalent)	(No.)	($'000)
Atlantic Provinces	108,394	2,273	408	10,845
Québec	54,253 (3)	1,522 (3)	316	39,216
Ontario	144,713 (4)	4,094 (4)	1,066	108,927
Ottawa - Hull	386,850	9,780	—	—
Manitoba	53,260	1,497	38	3,920
Saskatchewan	23,415	688	70	4,263
Alberta	44,395	1,286	94	4,808
British Columbia	69,730	1,604	482	21,009
Canada (5)	886,252	22,775	2,557	194,967

SOURCE: (1) "Listing of Federal Natural Science Establishments, 1979-80", Science Statistics Centre, Statistics Canada.

(2) Research and Development Bulletin, April 1981, Supply and Services.

(3) Excluding Hull.

(4) Excluding Ottawa.

(5) Includes the Yukon and Northwest Territories.

TABLE 9

International Comparisons of R & D in the Natural Sciences: (1979) (unless otherwise stated)

Country	TOTAL[1]		EXPENDITURES/GDP FUNDING SECTOR[2] Government	University	Industry	Others
B.C.	0.5%		0.24%	0.09%	0.14%	0.03%
Canada	< 1.0%		0.46%	0.14%	0.36%	0.04%
	1.5%	(1985 target)	0.59%	0.11%	0.75%	0.04%
Australia	1.0%	(1978/79)	0.56%	0.14%	0.26%	0.03%
Denmark	1.0%		0.27%	0.20%	0.51%	0.01%
Finland	1.1%		0.31%	0.16%	0.60%	0.02%
France	1.8%		0.67%	0.10%	0.74%	0.27%
Germany	2.4%		0.99%		1.33%	0.07%
Japan	2.0%	(1979/80)	0.32%	0.22%	1.32%	0.14%
Norway	1.4%		0.45%	0.35%	0.57%	0.03%
Sweden	1.9%		0.49%	0.24%	1.13%	0.04%
USA	2.5%		1.28%	0.08%	1.09%	0.05%

[1] *OECD Observer*, No. 115, March 1982, Pg. (26-27).

[2] Background Notes on R & D Policies, Planning and Programming for the Honourable John Roberts, Minister of State for Science and Technology and Minister of the Environment at a meeting of the Toronto Board of Trade, January 19, 1981. R & D Policies, Planning and Programming, January 1981, pg. 2.

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